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(54) Process and device for composting organic material.

(57) Process for aerobic composting of organic material, comprising of

successively aerating and fractionating this material in a number of steps, as according to the following steps of:

(1) aerating the material for a period of for instance between about two and about four weeks, in particular about three weeks.

(2) separating the material aerated in step (1) into a first fraction of coarse material and a second fraction of less coarse material;

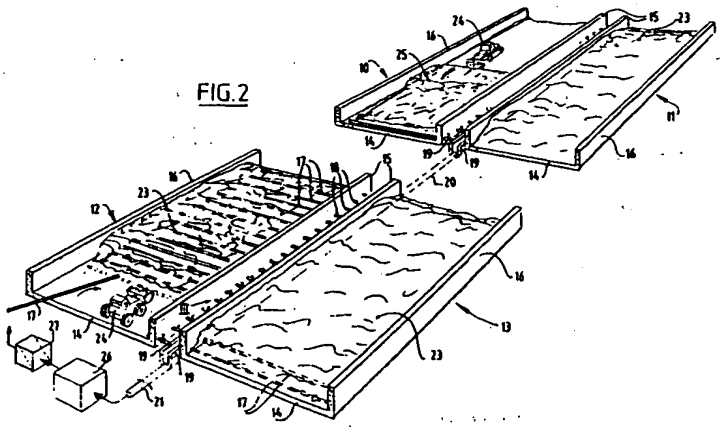
(3) aerating the coarse material again as according to step (1) and separately aerating for a second time the less coarse material for a period of between about four and about eight weeks, in particular about six weeks.

(4) separating the less coarse material aerated in step (3) into a third fraction of fine material and a fourth fraction of the finest material;

(5) aerating the fine material again as according to step (1) and

(6) discharging as compost the finest material separated in step (4), and device for aerobic composting of organic material according to this process.

FIG.2



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The invention relates to a process for aerobic composting of organic material, comprising of successively aerating and fractionating this material in a number of steps.

Such a process is known from the German patent specification DE-A-4 000 510, wherein a process and a device for composting waste are described. According to the known process, biological material is supplied separated from other compostible material and the different components are processed via separate lines. Prior to aerating the biological material is optionally reduced to a particle size of 10-40 mm and/or broken down to fibres in lengthwise direction.

Composting takes place in a closed device, which is very expensive. Composting in the outside air can however result in odour nuisance and other environmental problems.

The object of the invention is to provide a process for composting organic material in the outside air, wherein odour nuisance and other environmental problems do not occur.

The invention has for its particular objective to provide a process for composting organic waste with few contaminants, such as VFG waste (vegetable, fruit and garden waste). Composting of VFG waste generally runs up against great technical problems because the compact structure of the waste mass forms an obstacle to a good aeration and the organic composition, for instance the C/N (carbon/nitrogen) ratio is not optimal for an adequate biological break-down by organisms.

The object is achieved according to the invention with a process characterized by the following steps of:

(1) aerating the material;

(2) separating the material aerated in step (1) into a first fraction of coarse material and a second fraction of less coarse material;

(3) aerating the coarse material again as according to step (1) and separately aerating the less coarse material again;

(4) separating the less coarse material aerated in step (3) into a third fraction of fine material and a fourth fraction of the finest material;

(5) aerating the fine material again as according to step (1) and

(6) discharging the finest material as compost.

The composting process is further improved according to the invention by adding to the organic material and mixing therewith a compostible conditioning material.

As conditioning material can for instance be added a less coarse or fine material previously obtained in one of the steps (2) or (4).

It has also been found that by adding to the organic material for composting and mixing therewith wood trimmings, generally designated as wood chippings, the organic material can be conditioned such that the C/N ratio is optimal for an adequate biological degrading.

Composting of organic material, in particular VFG waste, proceeds optimally when a maximum of one volume part of wood trimmings is added to two volume parts thereof. The C/N ratio and the moisture content of a thus composed mixture are optimal for a rapid and homogeneous composting.

The composting process is still further improved according to the invention by means of forced aeration of the material in the steps (1), (3) and (5) with a downward air flow through the material.

Forced aeration of the material with a downward air flow has the important advantage, in addition to improved efficiency, that the gases released during composting can be collected in simple and effective manner for further treatment, whereby possible odour problems are eliminated.

The material for composting is preferably aerated by means of a branching system of aerating tubes, detachably connected end pieces of which system end beneath the material for aerating in the steps (1), (3) and (5).

The application of detachably connected end pieces enables adaptation of the system of aerating tubes in rapid and simple, and therefore inexpensive, manner to the surface of the heap of material for aerating.

Aerating of the material for composting is optimalized still further by controlling the gas flow rate through the end pieces of the aerating tubes.

The process according to the invention is preferably characterized by covering the material for composting during aerating in the steps (1), (3) and (5).

Covering of the material for composting has the important advantage that on the one hand the temperature of the mass for composting can be kept easily at the value required for the composting process, while on the other the gases released during composting do not escape into the atmosphere.

Covering of the material for composting is for example realized by pouring this material into a tray comprising a bottom and side walls and by covering the material with a layer of organic covering material.

A concrete tray is for instance used as tray comprising a bottom and side walls, wherein it is noted that simpler embodiments such as a pit covered with agricultural plastic is by no means excluded.

The process is characterized in embodiments by covering the material with wood trimmings or with coarse and fine material separated in at least one of the steps (2) and (4).

A thus covered material for composting is very well thermally insulated, while the removal and processing of the covering layer at the end of the composting of the underlying organic material does not require any special steps precisely because this layer consists of organic material for composting.

In one embodiment the process is characterized by separating the material in step (2) into a first fraction with particles having dimensions greater than c. 40 mm and a second fraction with particles having dimensions smaller than c. 40 mm.

In yet another embodiment the process is characterized by separating the material in step (4) into a third fraction with particles having dimensions greater than c. 15 mm and a fourth fraction with particles having dimensions smaller than c. 15 mm.

It has been found that material having particles with dimensions smaller than c. 40 mm is for the main part composted in a relatively short time by the aerating in step (3).

The aeration time of the material in step (1) amounts for instance to between two and about four weeks, in particular about three weeks.

The aerating of the material for the second time in step (3) takes place during a period of between about four and about eight weeks, in particular about six weeks.

When the quality of the starting material requires such, the process is characterized in a following embodiment by removal of non-compostible residual material present in the first fraction of coarse material separated in step (2).

The process is advantageously performed such that the gases released during the composting process are treated by being washed with percolation water originating from the composting process and subsequently being guided through a bio-filter.

A bio-filter is a filter with biologically active filter material whereby contaminated and usually odorous constituents of a biological nature in the gases are broken down.

Due to the washing of the gases ammonia vapours (NH_3) for instance are precipitated out of the gases. Treating of the gases resulting from the composting process in combination with treatment of the percolation water resulting from that process has the advantage that ammonia constituents are further subjected to the cleaning process of the percolation water, while on the other hand the percolation water is aerated due to its use as washing water for the gases, whereby anaerobia in the percolation water is avoided as far as possible.

Yet another embodiment of a process according to the invention is characterized by treating the gases released during the composting process by guiding them through a bio-filter filled with a filter material comprising a mixture of wood trimmings and tree-bark and compost in relative volume quantities of respectively about 45%, about 45% and about 10%.

It has been found that filtering of the composting gases in a bio-filter with such filter material removes from the composting gases the foul-smelling and environmentally damaging constituents thereof, or at least reduces them to a content such that the filtered gases can be released into the outside air without problem.

Organic material is preferably composted according to the invention in accordance with the process as shown in figure 1 of the annexed drawing.

The invention likewise relates to a device for aerobic composting of organic material which comprises devices for aerating and fractionating that material.

Such a device is known from the above cited German patent specification DE-A-4 000 510. As stated above, however, the known device has the drawback of very high costs.

Another object of the invention is therefore to provide a device with a low purchase price with which organic waste can be composted in an environmentally non-damaging manner at low operating cost.

This object is achieved according to the invention with a composting device characterized by at least

(1) a first aerating device for aerating the material;

(2) a first fractionating device for separating the material aerated in the first aerating device into a first fraction of coarse material and a second fraction of less coarse material;

(3) a second aerating device for separately aerating a second time the less coarse material coming from the first fractionating device;

(4) a second fractionating device for separating the material aerated in the second aerating device into a third fraction of fine material and a fourth fraction of the finest material.

In one embodiment the composting device comprises a device for adding to the organic material and mixing therewith a compostible conditioning material.

The device preferably comprises a suction device for forced aeration of the material in a downward air flow.

Such a suction device comprises for instance a branching system of aeration tubes, detachable end pieces of which system end in the lowest portion of the first and the second aerating device. The end pieces are for example perforated plastic tubes (for instance HDPE tubes) located on the

floor of the aerating device which are covered with a layer of air permeable organic material, for example wood chippings. Air is drawn out of the material for composting via these tubes using a pumping device. The extracted air is subsequently washed and filtered for example. A device provided with aerating tubes preferably comprises control means for controlling the gas flow rate through the end pieces. The end pieces are closed for instance at one outer end and provided in longitudinal direction with perforations having a diameter increasing in the direction of the outer end.

The composting device for the material for composting preferably comprises trays comprising a bottom and side walls. Such trays are for instance made of concrete but the invention is not limited thereto.

In yet another embodiment the composting device comprises a first fractionating device for separating the material into a first fraction with particles having dimensions greater than c. 40 mm and a second fraction with particles having dimensions smaller than c. 40 mm.

In still another embodiment the composting device comprises a second fractionating device for separating the material into a third fraction with particles having dimensions greater than c. 15 mm and a fourth fraction with particles having dimensions smaller than c. 15 mm.

Yet another embodiment is characterized by a device for removing non-compostible residual material present in the first fraction of coarse material separated in the second step.

Such a device for removing residual material comprises for instance a simple conveyor belt for manual sorting, but also comprises advanced detection and removal systems, for instance for ferromagnetic metal remnants and other inorganic contaminants.

With the process and in a device according to the invention relatively high-grade organic waste material (for instance VFG waste) can be composted rapidly and completely at comparatively low cost, wherein adverse side effects having an impact on the environment, namely the occurrence of stench caused by released gases, are eliminated or at least reduced to a considerable extent.

The invention will now be further elucidated hereinafter in respect of an embodiment and with reference to the drawing.

In the drawing:

figure 1 shows a block diagram for a process for composting according to the invention;

figure 2 shows a part of a composting device according to the invention in perspective view;

figure 3 shows a detail of the device according to figure 2;

figure 4 and figure 5 show an enlarged detail of figure 3.

Figure 1 shows the block diagram for a process for composting, according to which the material for composting is aerated in a first step 1, whereafter it is separated in a second step 2 by sieving into fractions with particles larger than about 40 mm and particles smaller than about 40 mm, which latter particles are aerated a second time in a third step 3. The particles larger than about 40 mm at the end of the second step are freed of inorganic remnants which are discharged as residue, while the organic material is fed back to be aerated again as according to the first step 1. The material composted in the third step 3 is sieved in a fourth step 4, whereafter a fraction with particles larger than 15 mm is again fed back to the first step 1 and a fraction with particles of dimensions smaller than 15 mm is discharged as finished compost. Before the organic material is aerated in the first step 1 it is mixed in a mixing device 6 with wood chippings. Water and air originating from the composting process are collected and fed respectively to a basin 7 with percolation water, a gas conditioning device 8 followed by a bio-filter 9.

Figure 2 shows four composting trays 10-13 each with a rectangular concrete bottom 14 and a pair of concrete standing edges 15, 16 along the long side. The cells are placed in a rectangle, wherein in each case two cells 10 and 11 respectively 12 and 13 lie mutually adjacent and in each case two cells 10 and 12 respectively 11 and 13 lie mutually in line. The mutually facing inner side walls 15 are provided with closable openings to which end pieces 17 of a system of aerating tubes can be fixed. The connecting openings in the walls 15 communicate via connecting tubes 18 with drain lines 19 which debouch into a central draining line 21 directly or via a collective underground drain line 20. The connecting openings in the cell walls 15 are situated at ground level. The air suction can be controlled in manual or automated manner per end piece 17 using an adjustable valve 22. The trays 10-13 have dimensions such that the material 23 for composting can be supplied using a wheel loader 24. As a composting tray 24 is filled, one end piece 17 of the aerating system is laid at a time on the bottom 14 of the tray 12 and then buried under material 23 for composting supplied with the wheel loader 24. When the heap of material on a particular end piece 17 is sufficiently high a second end piece 17 is laid and so on, until the whole tray 12 is filled. The emptying of a tray 10 with finished compost 25 takes place in reverse sequence; so much compost 25 is discharged that an end piece 17 is again exposed and can be removed, whereafter compost 25 lying further down

the tray 10 becomes accessible to the wheel loader 24. The figure further shows schematically a pumping device 26 and a filter 27 for respectively sucking in and purifying composting gases. Because the central draining tube 21 ultimately branches into the detachable end pieces 17 which end in at least four trays 10 – 13, one pump 26 can suffice, the capacity of which is smaller than the sum of the capacity of four pumps which would be required for each tray separately. Use is made herein of the fact that in normal operating conditions the trays 10 – 13 are not filled or emptied simultaneously. In the embodiment shown one tray 12 is partially filled, two trays 11, 13 are wholly filled and one tray 10 is already partially emptied. The debouching of the end pieces of different trays with material that is composted to a mutually differing extent provides the further advantage that the total flow rate of gases drawn from the different trays is quite constant on average, while this varies considerably in the course of time per separate tray, while moreover the temperature of the gas sucked in by pump 26 is likewise quite constant on average, which is important for an adequate biological cleaning in a bio – filter, for instance filter 27. The flow rate and the temperature of the gases released during composting can be controlled still further using the adjustable valves 22.

Figure 3 shows a detail of a tray 12 of figure 2 with a draining tube 19 from which, via connecting tubes 18, adjustable valves 22 and couplings 29, detachable end pieces 17 extend through a standing wall 15 from this wall 15, over the bottom 14 of a tray 12. The end pieces 17 are closed at the end and are provided in longitudinal direction with holes having a diameter increasing in the direction of the outer end, as shown in figures 4 and 5.

Figure 4 shows in detail the outer end 17e of end piece 17 with holes 28e.

Figure 5 shows a detail of a central portion 17m with holes 28m, the diameter of which is smaller than that of the holes 28e in figure 4.

Claims

1. Process for aerobic composting of organic material, comprising of
successively aerating and fractionating this material in a number of steps,
characterized by the following steps of:
(1) aerating the material;
(2) separating the material aerated in step (1) into a first fraction of coarse material and a second fraction of less coarse material;
(3) aerating the coarse material again as according to step (1) and separately aerating the less coarse material again;
(4) separating the less coarse material aerated in step (3) into a third fraction of fine material and a fourth fraction of the finest material;
(5) aerating the fine material again as according to step (1) and
(6) discharging the finest material as compost.

2. Process as claimed in claim 1, **characterized by** adding to the organic material and mixing therewith a compostible conditioning material.

3. Process as claimed in claim 2, **characterized in that** as conditioning material is added a less coarse material obtained previously in a step (2).

4. Process as claimed in claim 2, **characterized in that** as conditioning material is added a fine material obtained previously in a step (4).

5. Process as claimed in claim 2, **characterized in that** as conditioning material is added wood trimmings.

6. Process as claimed in claim 5, **characterized in that** a maximum of one volume part of wood trimmings is added to two volume parts of material for aerating.

7. Process as claimed in claim 1, **characterized by** forced aeration of the material in the steps (1), (3) and (5) with a downward air flow through the material.

8. Process as claimed in claim 7, **characterized by** aerating the material by means of a branching system of aerating tubes, detachably connected end pieces of which system end beneath the material for aerating in the steps (1), (3) and (5).

9. Process as claimed in claim 8, **characterized by** controlling the gas flow rate through the end pieces.

10. Process as claimed in any of the claims 1 – 9, **characterized by** covering the material for composting during aerating in the steps (1), (3) and (5).

11. Process as claimed in claim 10, **characterized by** pouring the material for composting into a tray comprising a bottom and side walls.

12. Process as claimed in claim 10, **characterized by** covering the material for composting

with a layer of organic covering material.

13. Process as claimed in claim 12, **characterized by** covering the material for composting with wood trimmings.

14. Process as claimed in claim 12, **characterized by** covering the material for composting with coarse and fine material separated in at least one of the steps (2) and (4).

15. Process as claimed in claim 1, **characterized by** separating the material in step (2) into a first fraction with particles having dimensions greater than c. 40 mm and a second fraction with particles having dimensions smaller than c. 40 mm.

16. Process as claimed in claim 1, **characterized by** separating the material in step (4) into a third fraction with particles having dimensions greater than c. 15 mm and a fourth fraction with particles having dimensions smaller than c. 15 mm.

17. Process as claimed in claim 1, **characterized by** aerating the material in step (1) for a period of between about two and about four weeks, in particular about three weeks.

18. Process as claimed in claim 1, **characterized by** aerating the material for the second time in step (3) for a period of between about four and about eight weeks, in particular about six weeks.

19. Process as claimed in claim 1, **characterized by** removing non-compostible residual material present in the first fraction of coarse material separated in step (2).

20. Process as claimed in any of the foregoing claims, **characterized by** treating the gases released during the composting process by washing them with percolation water originating from the composting process and subsequently guiding them through a bio-filter.

21. Process as claimed in any of the foregoing claims, **characterized by** treating the gases released during the composting process by guiding them through a bio-filter filled with a filter material comprising a mixture of wood trimmings and tree-bark and compost in relative volume quantities of respectively about 45%, about 45% and about 10%.

22. Process as illustrated in the annexed drawing, figure 1.

23. Device for aerobic composting of organic material according to a process as claimed in claim 1, which comprises devices for aerating and fractionating that material, **characterized by** at least
(1) a first aerating device for aerating the material;
(2) a first fractionating device for separating the material aerated in the first aerating device into a first fraction of coarse material and a second fraction of less coarse material;
(3) a second aerating device for separately aerating a second time the less coarse material coming from the first fractionating device; and
(4) a second fractionating device for separating the material aerated in the second aerating device into a third fraction of fine material and a fourth fraction of the finest material;

24. Device as claimed in claim 23 for performing a process according to claim 2, **characterized by** a device for adding to the organic material and mixing therewith a compostible conditioning material.

25. Device as claimed in claim 23 for performing a process according to claim 7, **characterized by** a suction device for forced aeration of the material in a downward air flow.

26. Device as claimed in claim 25 for performing a process according to claim 8, **characterized by** a branching system of aeration tubes, detachable end pieces of which system end in the lowest portion of the first and the second aerating device.

27. Device as claimed in claim 26 for composting in accordance with a process according to claim 9, **characterized by** control means for controlling the gas flow rate through the end pieces.

28. Device as claimed in claim 26, **characterized in that** the end pieces are closed at one outer end and provided in longitudinal direction with perforations having a diameter increasing in the direction of the outer end.

29. Device as claimed in any of the claims 23-28 for performing a process according to claim 11, **characterized by** at least one tray for the

material for composting to be poured therein.

30. Device as claimed in claim 23 for performing a process according to claim 15, **characterized by** a first fractionating device for separating the material into a first fraction with particles having dimensions greater than c. 40 mm and a second fraction with particles having dimensions smaller than c. 40 mm.

31. Device as claimed in claim 23 for performing a process according to claim 16, **characterized by** a second fractionating device for separating the material into a third fraction with particles having dimensions greater than c. 15 mm and a fourth fraction with particles having dimensions smaller than c. 15 mm.

32. Device as claimed in claim 23 for performing a process according to claim 19, **characterized by** a device for removing non-compostible residual material present in the first fraction of coarse material separated in the second step.

33. Device as claimed in any of the claims 23-32 for performing a process according to claim 20, **characterized by** a bio-filter and a gas washing device with means for feed thereto of percolation water originating from the composting process.

34. Device as claimed in any of the claims 23-32 for performing a process according to claim 21, **characterized by** a bio-filter filled with filter material comprising a mixture of wood trimmings and tree-bark and compost in relative volume quantities of respectively about 45%, about 45% and about 10%.

35. Device as claimed in claim 23, **characterized in that** the first aerating device comprises a branching system of aerating tubes, detachable end pieces of which end in the lowest portion of at least four trays provided with a bottom and at least one pair of opposite walls, wherein in each tray the end pieces extend in each case from one wall over the bottom and are provided with control means for controlling the gas flow rate through the end pieces.

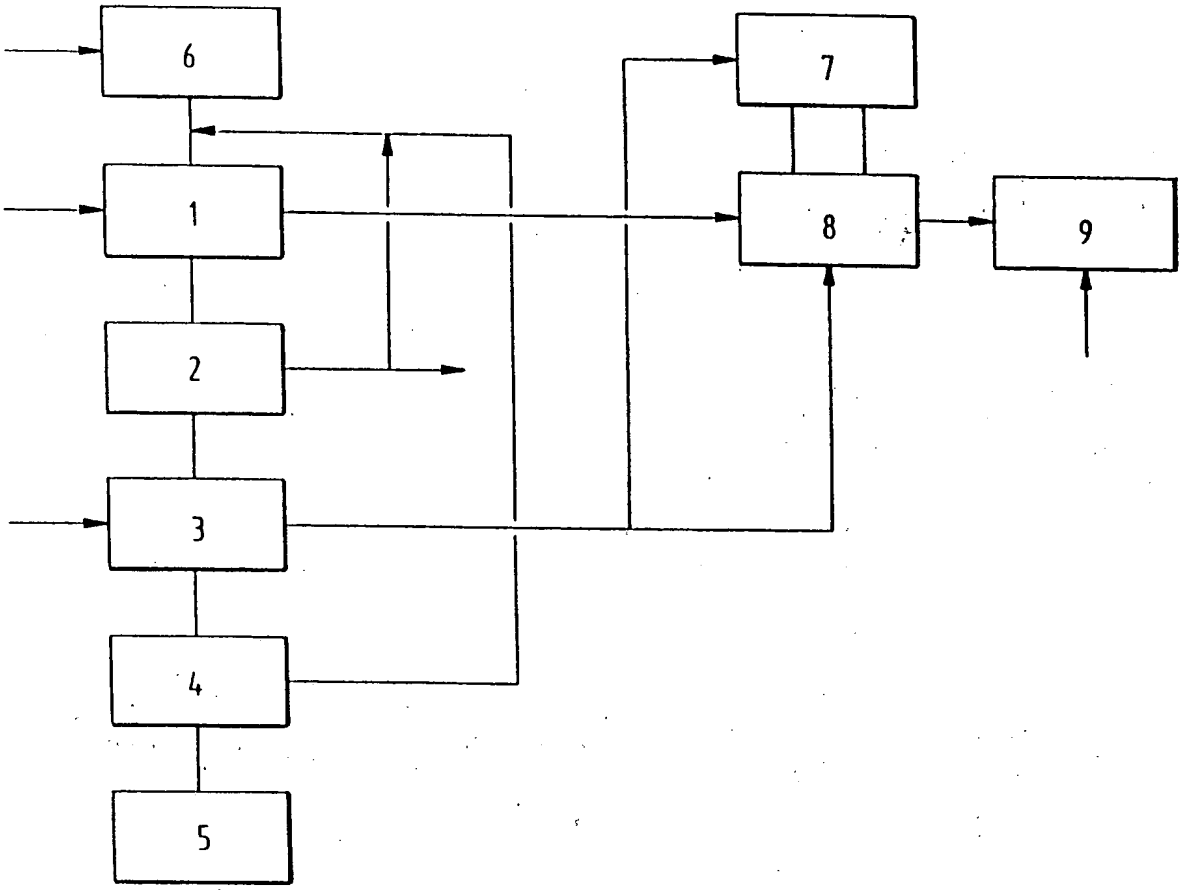

FIG.1

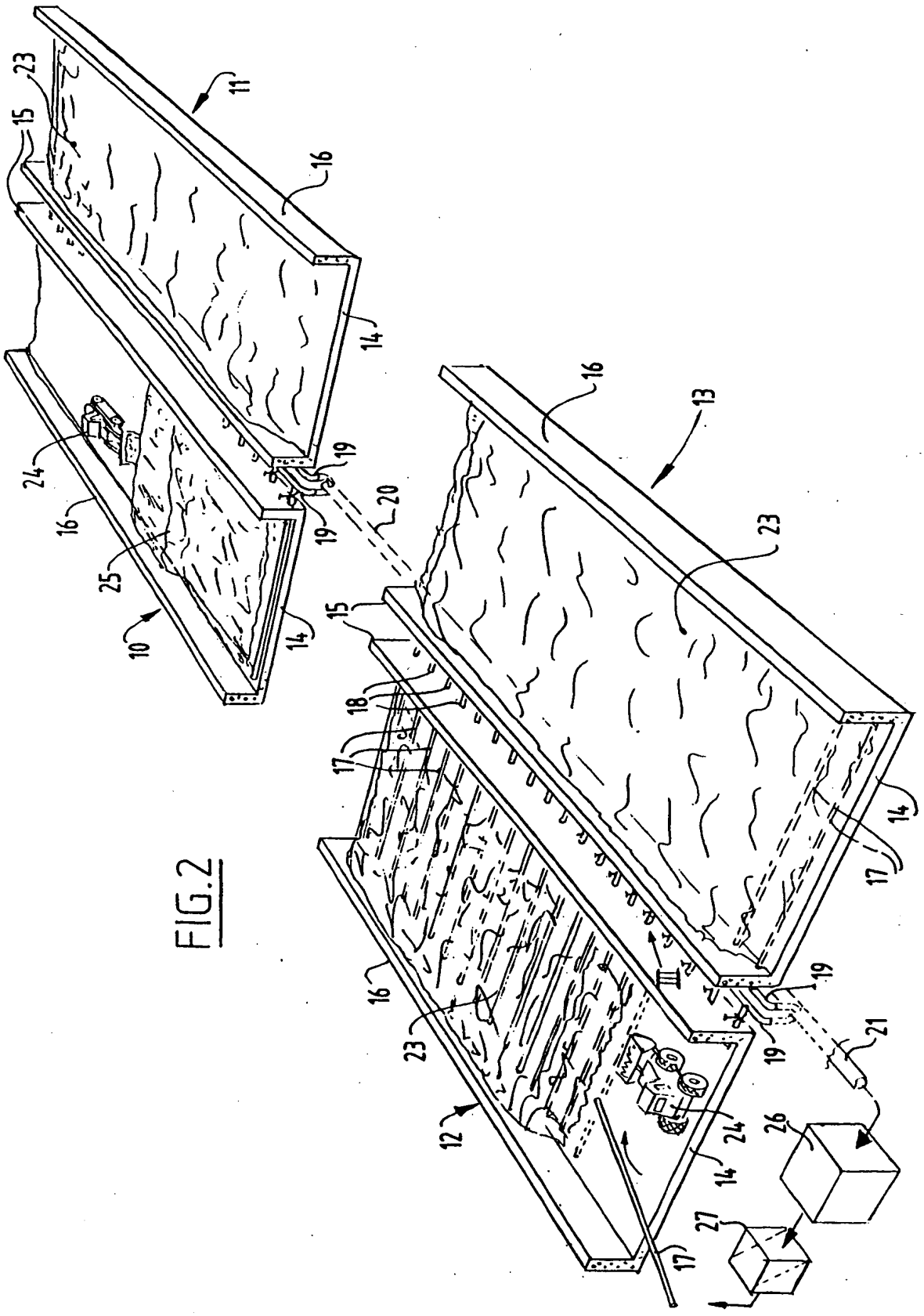
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FIG.2

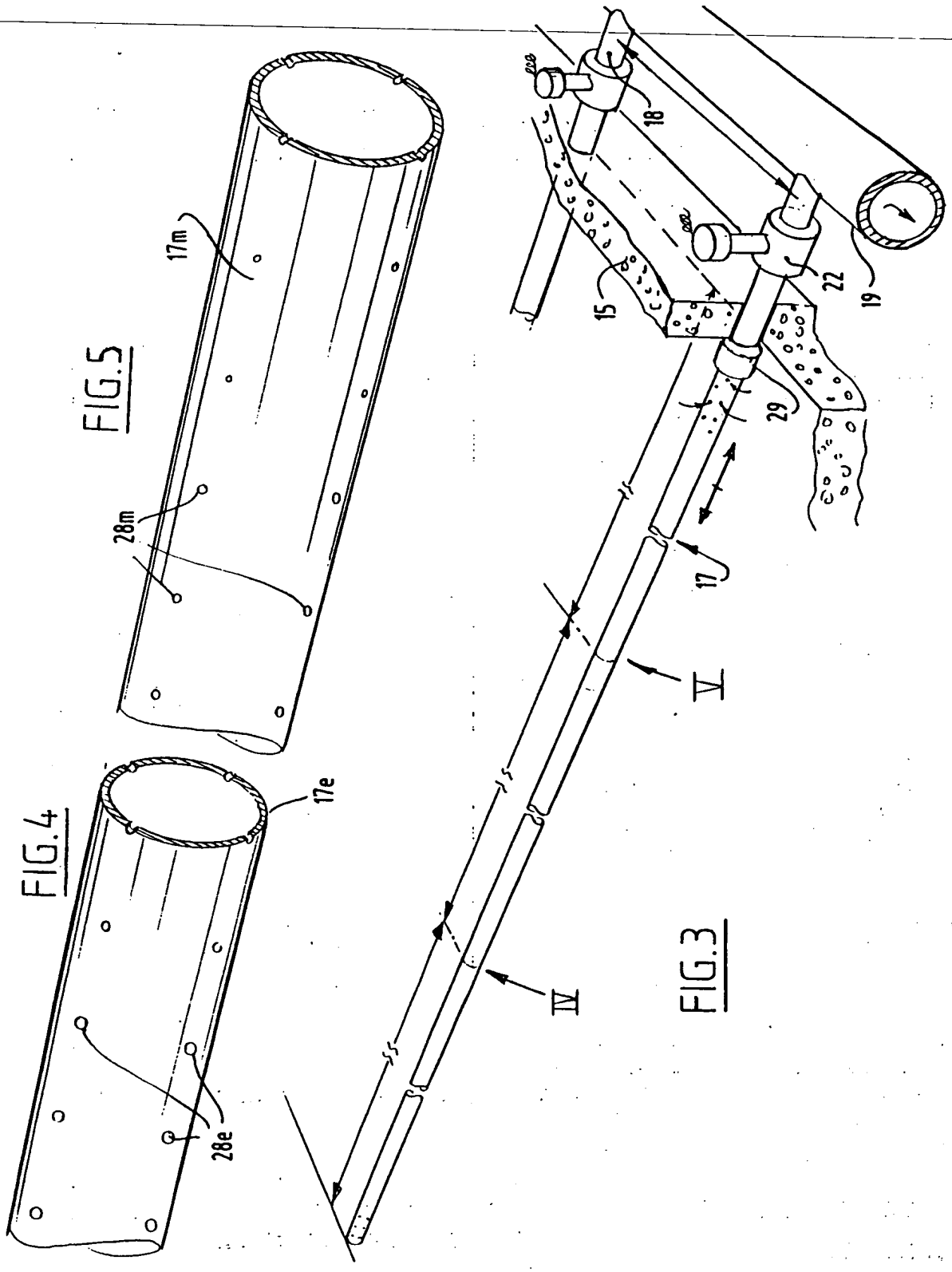

FIG.3

FIG.5

FIG.4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 20 3421

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
D,A	DE-A-4 000 510 (W. BÜRKLIN) * column 1, line 11 - line 30; claims * * column 5, line 27 - line 33; figure 1 *	1-35	C05F17/00 C05F17/02 B01D53/00 B01D51/10
A	EP-A-0 309 872 (SALZGITTER MASCHINENBAU GMBH) * column 3, line 4 - column 4, line 3; claims; figure 1 *	1-35	
A	WO-A-9 103 441 (ITK INGENIEUR-TECHNIK KOMPOST PLANUNGS GMBH) * page 3, line 26 - page 7, line 8; claims; figures 2,4,7 *	1-35	
A	EP-A-0 391 753 (M. TEMPE) * page 3, line 46 - line 48; claims * * page 4, line 57 - page 5, line 2 * * page 8, line 37 - line 44 *	1-35	
A	EP-A-0 040 147 (J.J. WEYNANDT ET AL.) * page 20, line 27 - line 33; claims 3,5,9,12,15; figure 1 *	1-35	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	AT-B-359 532 (WIENER BRÜCKENBAU- UND EISENKONSTRUKTIONS-AKTIENGESELLSCHAFT) * page 2, line 6 - line 20 * * page 2, line 43 - line 44 * * page 4, line 15 - line 22 *	17,18	C05F B01D
A	FR-A-2 264 792 (HAZEMAG DR. H. ANDREAS KG.) * claims *	10,12	
A	EP-A-0 356 816 (R. RÖMER) * claims 1,2 *	10,12	
A	FR-A-907 573 (R. MARTIN) * page 2, right column *	11,29	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	01 MARCH 1993	SCHUT R.J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	NL-A-8 303 031 (INGENIEURSBUR. VAN TONGEREN BV) * page 1, line 6 - line 16 * * page 5, line 12 - page 6, line 2 * * page 8, line 21 - line 27; figure 1 *	20-21, 26-28, 33-35	
A	EP-A-0 329 643 (VOEST ALPINE STAHL LINZ GMBH) * claims; figure 1 *	20-21, 26-28, 33-35	
A	DE-A-3 709 269 (R. SCHÜTTE) * column 5, line 18 - line 28; figure 1 *	20-21, 26-28, 33-35	
A	EP-A-0 296 645 (H. HOFMANN ET AL.) * page 2, line 48 - line 54 * * page 6, line 24 - line 27; claim 12; figure 1 *	20-21, 26-28, 33-35	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	DE-A-3 803 613 (SEEBECK TECHNOPRODUCT GMBH) * claims; figure 1 *	20-21, 26-28, 33-35	
A	EP-A-0 111 302 (MANNESMANN VEBA UMWELTTECHNIK GMBH) * page 4, line 5 - line 18; claims *	20-21, 26-28, 33-35	
A	EP-A-0 244 391 (VOEST-ALPINE AKTIENGESELLSCHAFT) * claim 1 *	20-21, 26-28, 33-35	

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L : document cited for other reasons

& : member of the same patent family, corresponding document

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EUROPEAN SEARCH REPORT

Application Number

EP 92 20 3421

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	AT-B-344 745 (WIENER BRÜCKENBAU- UND EISENKONSTRUKTIONS-AKTIEN-GESELLSCHAFT) * claims * ---	8,9, 26-28,35	
A	WO-A-8 601 198 (SORAIN CECCHINI S.P.A.) * claims; figure 1 * ---	8,9, 26-28,35	
A	EP-A-0 173 502 (J.G. LAURENSON,JR.) * page 11, line 03 - page 12, line 12 * -----	8,9, 26-28,35	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	01 MARCH 1993	SCHUT R.J.

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